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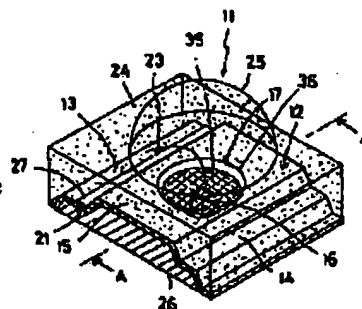
(72)Inventor : KOIKE AKIRA

(54) SURFACE MOUNT LIGHT EMITTING DIODE AND MANUFACTURE THEREOF

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a surface mount light emitting diode which is elongated in service life by improving a board where the light emitting diode is mounted in heat dissipating effect and prevented from deteriorating in brightness and to enable a variable wavelength light emitting diode to be applied to a surface mount light emitting diode.

SOLUTION: A reflection cap 17 is formed on the top surface 15 of a thin sheet metal 12, a light emitting diode 16 is placed on the bottom of the reflection cap 17, a first resin 35 mixed with wavelength conversion material is filled into the reflection cap 17 so as to bury the light emitting diode 16 in it, and furthermore the upper part of the thin sheet metal 12 which includes the reflection cup 17 is sealed up with a second resin 24 where a condenser lens 25 is formed, and the rear of the thin sheet metal 12 is filled up with a third resin 26.



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of luminescence brightness while prolonging the life of a light emitting diode component by heightening the heat dissipation effectiveness of a substrate of laying a light emitting diode component, and it aims at enabling it to apply wavelength conversion type light emitting diode to surface mount mold light emitting diode.

[0007]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the surface mount mold light emitting diode concerning claim 1 of this invention While forming the reflective cup section in the top face of sheet metal substrate and laying a light emitting diode component in the pars basilaris ossis occipitalis of this reflective cup section It is filled up with the 1st resin with which the charge of wavelength conversion material was mixed in reflective cup circles, and a light emitting diode component is laid underground into it. While closing the upper part of the sheet metal substrate which furthermore contains the reflective cup section by the 2nd resin by which the condenser lens section was formed, it is characterized by filling up the rear-face side of a sheet metal substrate with the 3rd resin.

[0008] Moreover, the surface mount mold light emitting diode concerning claim 2 of this invention is characterized by having filled up with the 3rd resin the concave heights which turned on the rear-face side of a sheet metal substrate, and reinforcing a sheet metal substrate according to this depression, while it is formed, when said reflective cup section dents the top face of a sheet metal substrate.

[0009] Moreover, surface mount mold light emitting diode concerning claim 3 of this invention is characterized by the top face of said 1st resin with which it filled up being lower than the upper limit edge of the reflective cup section.

[0010] Moreover, surface mount mold light emitting diode concerning claim 4 of this invention is characterized by the charge of wavelength conversion material mixed in said 1st resin being the fluorescent material which consists of fluorescent dye or a fluorescent pigment.

[0011] Moreover, surface mount mold light emitting diode concerning claim 5 of this invention is characterized by mixing at least one side in said 2nd resin among a dispersing agent and an ultraviolet ray absorbent.

[0012] Moreover, surface mount mold light emitting diode concerning this invention FU claim 6 is characterized by mixing in said 3rd resin the silica or glass filler formed a particle or in the shape of powder.

[0013] Moreover, surface mount mold light emitting diode concerning claim 7 of this invention is characterized by being the component of blue luminescence which said light emitting diode component becomes from a gallium nitride system compound semiconductor or a silicon carbide system compound semiconductor.

[0014] Moreover, surface mount mold light emitting diode concerning claim 8 of this invention is characterized by the above-mentioned sheet metal substrate being the outstanding electric conduction metal of thermal conductivity with a thickness of 0.5mm or less.

[0015] Moreover, the manufacture approach of the surface mount mold light emitting diode concerning claim 9 of this invention The press process which pierces the slit for forming the two electrodes of light emitting diode in a sheet metal substrate while denting the top face of a sheet metal substrate and forming the reflective cup section, Like the 3rd resin packer who fills up with the 3rd resin the concave heights which turned on the rear-face side of a sheet metal substrate, and reinforces a sheet metal substrate The die bond process which lays a light emitting diode component in the reflective cup of a sheet metal substrate, and is connected to one electrode, The wire bond process of connecting a light emitting diode component and the electrode of another side formed of said slit by the bonding wire, It is characterized by having the 1st resin seal process which is filled up with the 1st resin with which the charge of wavelength conversion material was mixed in reflective cup circles, and lays a light emitting diode component underground into it, and the 2nd resin seal process which closes the upper part of the sheet metal substrate containing the reflective cup section by the 2nd resin.

[0016] Moreover, the manufacture approach of the surface mount mold light emitting diode concerning claim 10 of this invention The set substrate which carries out press working of sheet

metal of the sheet metal, and consists of two or more sheet metal substrates is formed. The 3rd resin packer for reinforcing the above-mentioned sheet metal substrate to this set substrate After performing the die bond process of a light emitting diode component, a wire bond process, the 1st resin seal process, and the 2nd resin seal process, a set substrate is cut along division Rhine assumed by the set substrate, and it is characterized by dividing for each light emitting diode of every.

[0017]

[Embodiment of the Invention] Hereafter, the gestalt of operation of the surface mount mold light emitting diode applied to this invention based on an accompanying drawing and the manufacture approach is explained to a detail. Drawing 1 and drawing 2 show the 1st example of the surface mount mold light emitting diode 11 concerning this invention. Instead of the conventional glass epoxy group plate, the sheet metal substrate 12 which carried out press forming of the sheet metal with sufficient thermal conductivity, such as copper, and iron or phosphor bronze, to the predetermined configuration is used for the surface mount mold light emitting diode 11 concerning this example. This sheet metal substrate 12 is the thing of abbreviation trapezoidal shape which has the level difference sections 13 and 14 on both sides, and the reflective cup section 17 which holds the light emitting diode component 16 is formed in the center section of the top face 15. This reflective cup section 17 is what dented the top face 15 in the shape of a earthenware mortar by press forming, and is formed by the base 18 of a circle configuration in which the light emitting diode component 16 is laid, and the inner skin 19 which spreads above. In order to set up whenever [tilt-angle / of inner skin 19] so that diffusion of the light from the light emitting diode component 16 may be suppressed and it may lead upwards as much as possible, and to gather the reflection factor of the light from the light emitting diode component 16, inner skin 19 is mirror plane finishing.

[0018] The slit 21 parallel to the level difference section 14 of another side was formed in one level difference section 13 of the above-mentioned sheet metal substrate 12, and this slit 21 has separated the sheet metal substrate 12 into two. Since sheet metal substrate 12 the very thing is conductivity, by forming such a slit 21, on both sides of a slit 21, a die bond electrode is formed in the reflective cup section 17 side, and the wire bond electrode is formed in the level difference section 13 side of the opposite side, respectively. The slit 21 is closed by the non-conductive masking tape 27. In addition, light reflex effectiveness can go up by plating to the sheet metal substrate 12, and generating of rust etc. can be prevented. Plating uses nickel plating for a substrate and well-known means, such as giving silver plating on it, can perform it.

[0019] The light emitting diode component 16 arranged at the reflective cup section 17 of the above-mentioned sheet metal substrate 12 is the minute chip of an abbreviation cube configuration, and has an electrode on an inferior surface of tongue and the top face, respectively. And an inferior-surface-of-tongue electrode is fixed with electroconductive glue 22 on the base 18 of the reflective cup section 17, and a flow is achieved by connecting with the wire bond electrode in which the top-face electrode was prepared by the bonding wire 23 at the level difference section 13 of the opposite side of a slit 21. The component of blue luminescence which consists of a gallium nitride system compound semiconductor or a silicon carbide system compound semiconductor is used for the light emitting diode component 16 in this example.

[0020] The above-mentioned reflective cup section 17 is filled up with the 1st resin 35 which mixed the charge of wavelength conversion material, and said light emitting diode component 16 is laid underground in this. The fluorescent material which consists of fluorescent dye, a fluorescent pigment, etc. is used for this charge of wavelength conversion material, it can be excited by the blue light emitting diode component, and the light of long wavelength can be emitted, for example, the blue luminescent color can be changed into white etc. Moreover, although the transparence resin of an epoxy system is used for the resin material which mixes a fluorescent material, the wavelength field changed by changing the amount of mixing of a fluorescent material can be adjusted. Furthermore, as shown also in drawing 1 and drawing 2, the top face is a location lower than the upper limit edge 36 of the reflective cup section 17, and, as for the fill of the 1st resin 35, it is desirable not to jump out from the upper limit edge 36 of the

reflective cup section 17 at least. When contiguity arrangement of two or more surface mount mold light emitting diodes 11 is carried out, this is intercepting one luminescence on the upper limit edge 36 of the reflective cup section 17 of another side, and prevents color mixture. In addition, organic fluorescent substances, such as a fluorescein and a rhodamine, can be used as fluorescent dye used as said fluorescent material, and inorganic fluorescent substances, such as calcium wolframate, can be used as a fluorescent pigment.

[0021] The closure of the upper part of the sheet metal substrate 12 containing the above-mentioned reflective cup section 17 is carried out with the 2nd resin 24. This 2nd resin 24 also uses the transparency resin of an epoxy system as a principal component, and the ultraviolet ray absorbent for preventing the dispersing agent for improving homogeneity of the luminescent color by which wavelength conversion was carried out by the 1st resin 35, and aging of resin etc. is mixed in this. moreover, the 2nd resin 24 -- the thin metal substrate 12 and abbreviation -- the rectangular parallelepiped configuration of the same appearance is carried out, and the semi-sphere-like condenser lens section 25 is projected and formed in the top-face center section at one. This condenser lens section 25 is located above the reflective cup section 17, and has the work as a convex lens which condenses luminescence from the light emitting diode component 16 which carried out wavelength conversion by the 1st resin 35 of the reflective cup section 17. That is, although divided into that to which the light emitted from the light emitting diode component 16 goes straight on up as it is, and the thing which goes up after reflecting by the inner skin 19 of the reflective cup section 17, after wavelength conversion of any light is carried out with the 1st resin 35, since it is condensed in both the condenser lens sections 25, white luminescence of high brightness will be obtained. In addition, neither the radius of curvature of the condenser lens section 25, nor a configuration and a refractive index are limited especially in the range in which condensing is obtained. In addition, an aluminum oxide, a silicon dioxide, etc. can be used as the above-mentioned dispersing agent, and salicylic acid derivatives, a 2-hydroxy benzophenone derivative, etc. can be used as an ultraviolet ray absorbent.

[0022] On the other hand, since thickness is as thin as 0.5mm or less, in order that the sheet metal substrate 12 may secure in a predetermined location the sheet metal substrate 12 separated by the slit 21 in order to reinforce this, the 3rd resin 26 is arranged in the rear-face side of the sheet metal substrate 12. The level difference sections 13 and 14 and the reflective cup section 17 were filled up with this 3rd resin 26 that there is no clearance in the concave heights which turned on the rear-face side of the sheet metal substrate 12, and it has reinforced the sheet metal substrate 12 from the rear-face side by them. Although the principal component of this 3rd resin 26 is resin of an epoxy system as well as the 2nd resin 24 of the above, it does not need to be transparent in this case. Moreover, in order to bring the 3rd resin 26 close to the coefficient of linear expansion of the sheet metal substrate 12, while optimum dose mixing is carried out and a particle or powder, such as a silica and a glass filler, can heighten the reinforcement effectiveness further by this, the heat dissipation effectiveness by the 3rd resin 26 can also be heightened. Therefore, if coefficient of linear expansion is the add-in material which has near and insulation in it of the sheet metal substrate 12, it will not be limited to an above-mentioned thing.

[0023] As shown in drawing 2, the surface mount mold light emitting diode 11 which consists of the above-mentioned configuration can be directly mounted in the top face of a mother board 28. That is, the surface mount mold light emitting diode 11 is laid upward on electrode pattern 29a currently formed in the top face of a mother board 28, and 29b, and mounting of light emitting diode which stopped the height dimension is completed by joining the level difference sections 13 and 14 of the right-and-left both sides of the sheet metal substrate 12 to each electrode patterns 29a and 29b of a mother board 28 with solder 30. Thus, from the surface mount mold light emitting diode 11 mounted in the mother board 28, while the light changed into white luminescence from blue luminescence has above directivity, it is emitted. Moreover, although the heat produced when the light emitting diode component 16 emitted light is transmitted to a mother board 28 through the sheet metal substrate 12 and the 3rd resin 26, since both heat conductivity is very good, it gets across to a mother board 28 quickly, and radiates heat outside.

[0024] Drawing 3 thru/or drawing 7 show the manufacture approach of the surface mount mold

light emitting diode 11 which consists of the above-mentioned configuration. This manufacture approach is an approach in the case of manufacturing much light emitting diodes to coincidence using a set substrate. At the 1st press process, as shown in drawing 3 (a) and (b), press forming of many sheet metal substrates 12 is carried out to a big sheet metal, and the set substrate 31 is formed. The level difference sections 13 and 14 and the reflective cup section 17 are formed in each sheet metal substrate 12, respectively, and the slit 21 for separation is also established to coincidence with a press, and a masking tape 27 closes a it top.

[0025] Subsequently, as shown in drawing 4, the concave heights the set substrate 31 has turned on the rear-face side of inside-out and each sheet metal substrate 12 are filled up with the 3rd resin 26. The 3rd resin 26 seems not to leak and come out of a slit 21, since the slit 21 is closed by the masking tape 27 at this time. After restoration, immediately, the set substrate 31 is put into a cure furnace, and the 3rd resin 26 is stiffened.

[0026] The set substrate 31 taken out from the cure furnace is placed upward, and as shown in drawing 5, adhesion immobilization of the light emitting diode component 16 is carried out through electroconductive glue 22 on the base 18 of the reflective cup section 17 of each sheet metal substrate 12. After putting into a cure furnace again and fixing the light emitting diode component 16, a bonding wire 23 ties the top-face electrode of the light emitting diode component 16, and the wire bond electrode of the sheet metal substrate 12.

[0027] Subsequently, as shown in drawing 6, the 1st resin 35 which mixed the fluorescent material is slushed in the reflective cup section 17, and it is filled up to the location in which the top face of the light emitting diode component 16 hides. In addition, as mentioned above, it warns against being filled up to the upper limit edge 36 of the reflective cup section 17. It puts into the cure furnace after restoration, and heat curing of the 1st resin 35 is carried out.

[0028] At the 2nd following resin seal process, the resin of an epoxy system is poured in in the shaping metal mold 34 for fabricating the condenser lens section 25 to coincidence, and the 2nd resin 24 which confined the light emitting diode component 16 and bonding wire 23 by which the resin seal was carried out by the 1st resin 35 as shows the set substrate 31 by carrying out a face down on it at drawing 7 is formed in the whole upper part of the set substrate 31. Thus, after also forming the condenser lens section 25 in one, the set substrate 31 is again put into a cure furnace, and heat curing of the 2nd resin 24 is carried out.

[0029] division Rhine 32 and 33 of X and the direction of Y assumed by the set substrate 31 in the final process as shown in drawing 8 -- meeting -- the set substrate 31 -- the shape of a grid -- dicing -- or slicing is carried out and it divides each surface mount mold light emitting diode 11 of every. With an automatic mounting machine, vacuum adsorption of each is carried out, and each divided chip is transported on a mother board 28, and progresses to the following mother board mounting process.

[0030] Drawing 9 and drawing 10 show the 2nd example of the surface mount mold light emitting diode 11 concerning this invention. Since the surface mount mold light emitting diode 11 concerning this example consists of the same configuration as the surface mount mold light emitting diode concerning a previous example except having established by half dicing rather than depending the slit 21 of the sheet metal substrate 12 on press forming, detailed explanation is omitted. In addition, in this example, a part of 3rd resin 26 will project in the top-face side of the sheet metal substrate 12 from a slit 21.

[0031] Drawing 11 thru/or drawing 17 show the manufacture approach of the surface mount mold light emitting diode 11 in the 2nd example of the above, is having used the above-mentioned half dicing, and differs from the above-mentioned manufacture approach somewhat. By the manufacture approach concerning this example, as shown in drawing 11 (a) and (b), in case press forming of the sheet metal is carried out and the set substrate 31 is formed, a slit 21 for separation like a previous example is not formed.

[0032] The following die bond process and following wire bond process of the light emitting diode component 16 As shown in drawing 12, adhesion immobilization of the light emitting diode component 16 is carried out through electroconductive glue 22 on the base 18 of the reflective cup section 17 of each sheet metal substrate 12 from the top-face side of the set substrate 31. After

putting this into a cure furnace and fixing the light emitting diode component 16, a bonding wire 23 ties one level difference section 13 of the sheet metal substrate 12 with which the top-face electrode and wire bond electrode of the light emitting diode component 16 are formed.

[0033] At the 1st resin seal process shown in drawing 13, like a previous example, the 1st resin 35 is laid underground in the reflective cup section 17, and optimum dose casting and the light emitting diode component 16 are laid underground into it. After being filled up so that it may not reach to the upper limit edge 36 of the reflective cup section 17, it puts into a cure furnace and it is made to carry out heat curing.

[0034] Also in the 2nd following resin seal process, resin is poured in like a previous example in the shaping metal mold 34 for carrying out coincidence shaping of the 2nd resin 24 and condenser lens section 25, and the 2nd resin 24 which confined the light emitting diode component 16 and bonding wire 23 by which the resin seal was carried out by the 1st resin 35 as showed the set substrate 31 by carrying out a face down on it at drawing 14 is formed. Thus, after forming the condenser lens section 25 in one, the set substrate 31 is again put into a cure furnace, and heat curing of the 2nd resin 24 is carried out.

[0035] Next, as shown in drawing 15, the slit 21 for inside-out and electrode separation is put in for the set substrate 31. The half dicing of this slit 21 is carried out to one level difference section 13 of the sheet metal substrate 12 from a rear-face side, and it cuts a part of 2nd resin 24 together with the sheet metal substrate 12. According to this half dicing process, separation formation of a die bond electrode and the wire bond electrode can be carried out at the sheet metal substrate 12.

[0036] As shown in drawing 16, after carrying out half dicing, the 3rd resin 26 is filled up with and reinforced at the rear-face side of the set substrate 31. Since each slit 21 which carried out [above-mentioned] half dicing is also filled up with the 3rd resin 26 at this time and it enters into a part of 2nd resin 24, an electrode on either side is completely separable. It puts into a cure furnace immediately after restoration, and heat curing of the 3rd resin 26 is carried out.

[0037] division Rhine 32 and 33 of X and the direction of Y assumed by the set substrate 31 like the previous example as the final process was shown in drawing 17 -- meeting -- the set substrate 31 -- the shape of a grid -- dicing -- or slicing is carried out and it divides each surface mount mold light emitting diode 11 of every.

[0038] in addition, the above -- although any example explained the connection method using a bonding wire 23, this invention is not limited to this and connection methods, such as flip chip mounting using [for example,] the solder bump, are also included.

[0039]

[Effect of the Invention] Since the substrate for laying a light emitting diode component is formed with a sheet metal with sufficient heat-conduction effectiveness and it enabled it to radiate heat quickly from a mother board in generation of heat with a light emitting diode component according to the surface mount mold light emitting diode concerning this invention as explained above, it is effective in being applicable to the light emitting diode of the type into which the luminescent color is changed by wavelength conversion also in surface mount mold light emitting diode.

[0040] Moreover, since the top face of the 1st resin with which reflective cup circles are filled up was made lower than the upper limit edge of this reflective cup section according to this invention, color mixture can be prevented, without luminescence of one light emitting diode affecting the light emitting diode of another side, even if it carries out contiguity arrangement of two or more light emitting diodes.

[0041] Moreover, since the particle or powder of the silica near a metale coefficient of linear expansion or a glass filler is mixed in the 3rd resin which reinforces a sheet metal substrate according to this invention, in addition to reinforcement of a sheet metal substrate being trustworthy, these mixing can also raise the heat dissipation effectiveness of the 3rd resin to coincidence.

[0042] Moreover, according to the manufacture approach of the surface mount mold light emitting diode concerning this invention, since a substrate can be formed only by press working of sheet metal of a sheet metal, compared with the conventional glass epoxy group plate, the cost can be

cut down sharply. Moreover, surface mount mold light emitting diode can be obtained simply and in large quantities by having adopted the production process which carries out batch processing on the set substrate which consists of a sheet metal, a large cost cut is possible, and economical effectiveness is size. furthermore, the condenser lens section is fabricated by closure resin and one, and also automatic mounting to a mother board is possible -- etc. -- man day reduction and the improvement in the yield -- improvement in dependability etc. can be aimed at further.

[Translation done.]

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CLAIMS

[Claim(s)]

[Claim 1] While forming the reflective cup section in the top face of a sheet metal substrate and laying a light emitting diode component in the pars basilaris ossis occipitalis of this reflective cup section It is filled up with the 1st resin with which the charge of wavelength conversion material was mixed in reflective cup circles, and a light emitting diode component is laid underground into it. Surface mount mold light emitting diode characterized by filling up the rear-face side of a sheet metal substrate with the 3rd resin while closing the upper part of the sheet metal substrate which furthermore contains the reflective cup section by the 2nd resin by which the condenser lens section was formed.

[Claim 2] Said reflective cup section is surface mount mold light emitting diode according to claim 1 characterized by having filled up with the 3rd resin the concave heights which turned on the rear-face side of a sheet metal substrate, and reinforcing a sheet metal substrate according to this depression while being formed by denting the top face of a sheet metal substrate.

[Claim 3] Surface mount mold light emitting diode according to claim 1 with which the top face of said 1st resin with which it filled up is characterized by being lower than the upper limit edge of the reflective cup section.

[Claim 4] Surface mount mold light emitting diode according to claim 1 characterized by the charge of wavelength conversion material mixed in said 1st resin being the fluorescent material which consists of fluorescent dye or a fluorescent pigment.

[Claim 5] Surface mount mold light emitting diode according to claim 1 characterized by mixing at least one side in said 2nd resin among a dispersing agent and an ultraviolet ray absorbent.

[Claim 6] Surface mount mold light emitting diode according to claim 1 characterized by mixing in said 3rd resin the silica or glass filler formed a particle or in the shape of powder.

[Claim 7] The surface mount mold light emitting diode according to claim 1 characterized by being the component of blue luminescence which said light emitting diode component becomes from a gallium nitride system compound semiconductor or a silicon carbide system compound semiconductor.

[Claim 8] The above-mentioned sheet metal substrate is surface mount mold light emitting diode according to claim 1 or 2 characterized by thickness being the outstanding electric conduction metal with a thermal conductivity of 0.5mm or less.

[Claim 9] The press process which pierces the slit for forming the two electrodes of light emitting diode in a sheet metal substrate while denting the top face of a sheet metal substrate and forming the reflective cup section, Like the 3rd resin packer who fills up with the 3rd resin the concave heights which turned on the rear-face side of a sheet metal substrate, and reinforces a sheet metal substrate The die bond process which lays a light emitting diode component in the reflective cup of a sheet metal substrate, and is connected to one electrode, The wire bond process of connecting a light emitting diode component and the electrode of another side formed of said slit by the bonding wire, The 1st resin seal process which is filled up with the 1st resin with which the charge of wavelength conversion material was mixed in reflective cup circles, and lays a light emitting diode component underground into it, The manufacture approach of the surface mount mold light emitting diode characterized by having the 2nd resin seal process which closes the upper part of the sheet metal substrate containing the reflective cup section by the 2nd resin.

[Claim 10] The set substrate which carries out press working of sheet metal of the sheet metal, and consists of two or more sheet metal substrates is formed. The 3rd resin packer for reinforcing the above-mentioned sheet metal substrate to this set substrate After performing the die bond process of a light emitting diode component, a wire bond process, the 1st resin seal process, and the 2nd resin seal process, The manufacture approach of the surface mount mold light emitting diode according to claim 9 characterized by cutting a set substrate along division Rhine assumed by the set substrate, and dividing for each light emitting diode of every.

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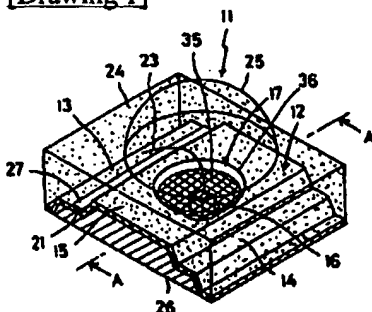
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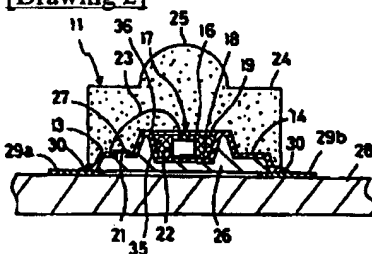
DRAWINGS

[Drawing 1]

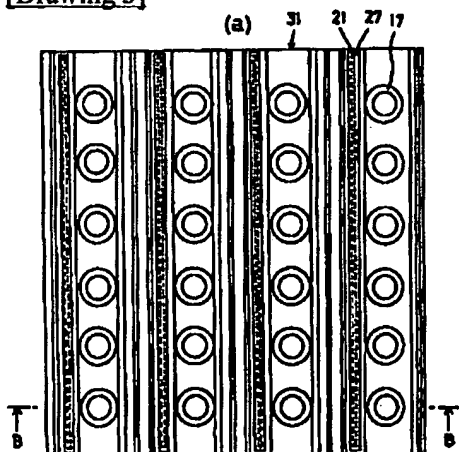


- 11--表面反射層
- 12--半導体層
- 13--上層
- 14--発光ダイオード層
- 15--反射キャップ層
- 16--第2の層
- 17--発光レンズ層
- 18--第3の層
- 19--第1の層
- 20--反射キャップ層の上層

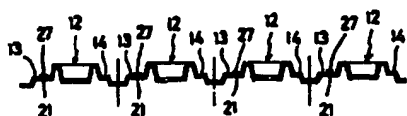
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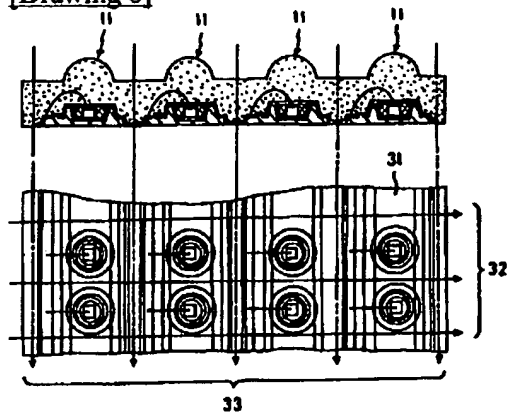
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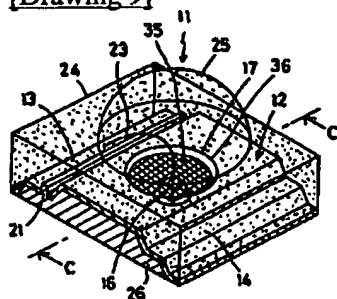
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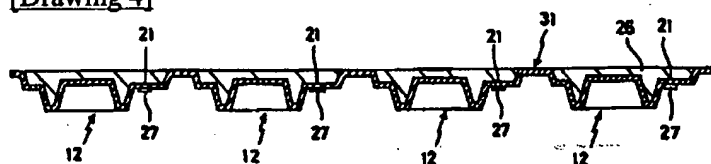
[Drawing 8]



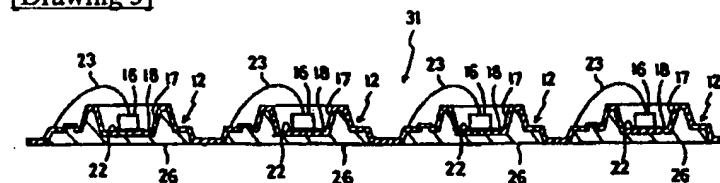
[Drawing 9]



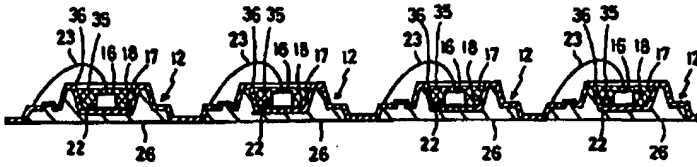
[Drawing 4]



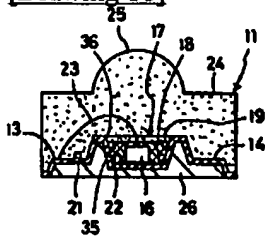
[Drawing 5]



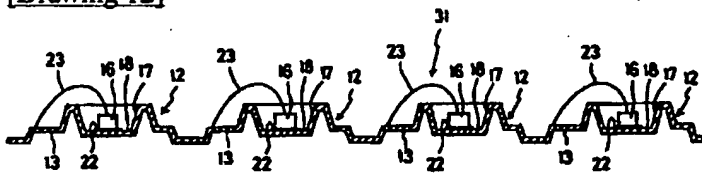
[Drawing 6]



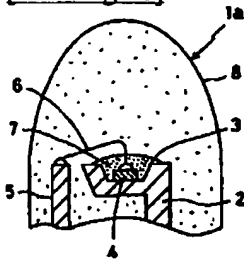
[Drawing 10]



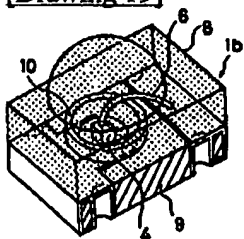
[Drawing 12]



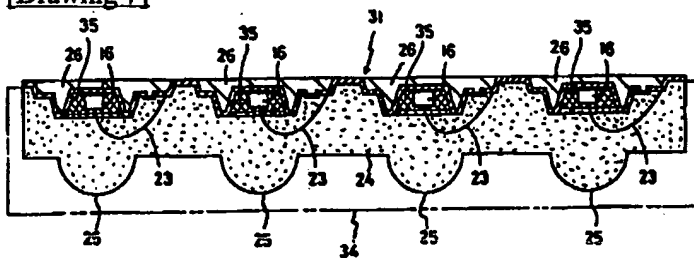
[Drawing 18]



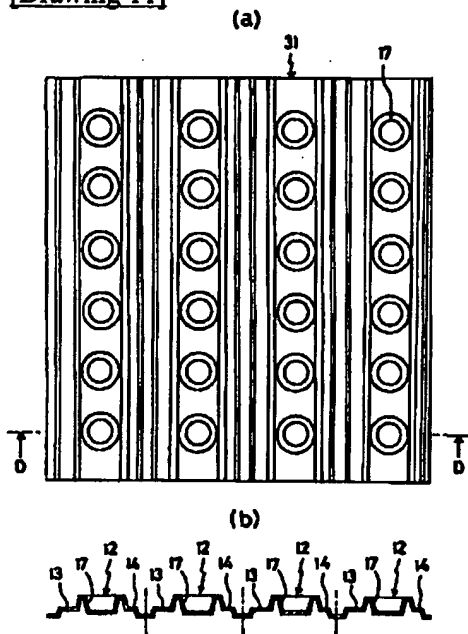
[Drawing 19]



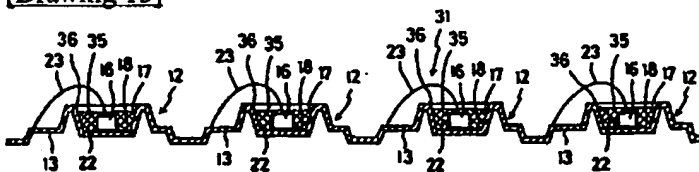
[Drawing 7]



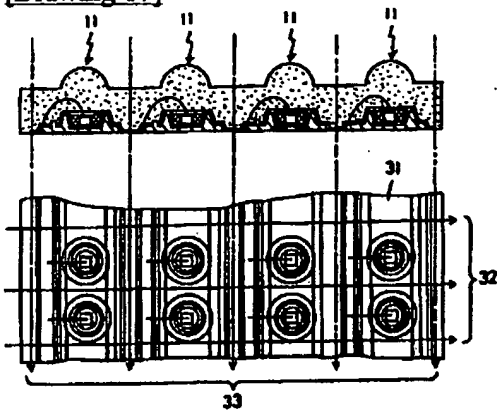
[Drawing 11]



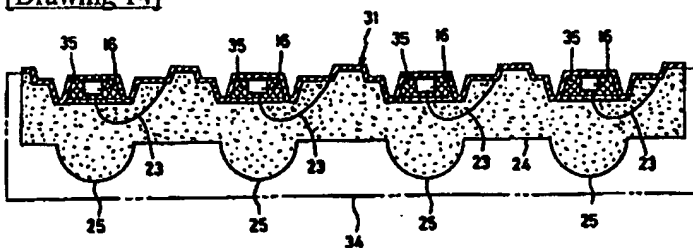
[Drawing 13]



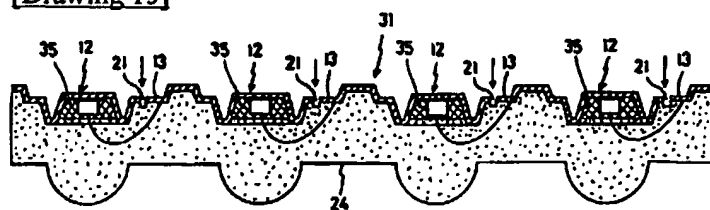
[Drawing 17]



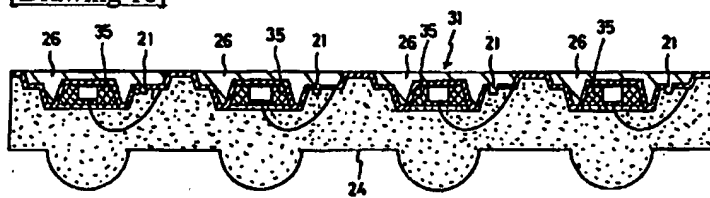
[Drawing 14]



[Drawing 15]



[Drawing 16]



[Translation done.]